suffered no injury from travelling. Since my arrival, I am pleased to say to you, that the wound on my face has *entirely* healed, both *inside* and outside the new formed ala. The new skin internally, is *entirely sound* and *healthy*, and all swelling has subsided. The scar on the face is hardly observable, and the adjacent parts have accommodated themselves, as well as I could expect, under all the circumstances, to the altered condition of the nose and cheek. The nostril appears natural but not quite large enough; and there seems to be a disposition in the part still farther to contract, though I hope it may eventually be overcome."

"N. B. My general health is very good, and I am as actively engaged in business as ever."

I have no doubt whatever, but that in the course of a few months, all "*tendency to contraction*" will be overcome.

ART. V. *On the Theory of Inflammation.* By MARTYN PAINE, M. D., of the City of New York.

Having formerly trusted to the general accuracy of microscopical observations, we were disposed to conclude that there is a languid state of the circulation in inflammatory affections. Still we could as little reconcile the phenomena of inflammation with the principles of mechanical or chemical philosophy, as those analogies that are supplied by other diseases. We, therefore, were irresistibly led to revert to the laws that govern living matter, whenever we attempted an explanation of its results, or of the modus operandi of remedies. These difficulties brought us to a more critical examination of the subject, which has resulted in restoring our confidence in the Hunterian theory.

The objections against the new doctrine appear to be its inadequacy to explain most of the phenomena, whilst it seems to us to be contradicted by the principles upon which it is founded. As we have nothing in other respects new to offer, we shall confine ourselves, mainly, to a consideration of the obstacles presented by the theory itself.

Having satisfied ourselves of the suspected illusions of the microscope, when employed in minute investigations where the vital powers and actions mainly reside, we turned our attention to the results that had been obtained from this instrument by different observers. We found but little agreement amongst them, excepting as to the dilatation of the vessels, and an increased volume of blood; and even the latter phenomenon, like pain, is a contingent result, and not a necessary element of inflammation.

We shall take Mr. Earle's very lucid digest of the existing doctrines of inflammation* for our guide; and shall consider that part of the theory of passive relaxation, which he has propounded in regard to the products and supposed terminations of inflammation, as irresistibly resulting from the fundamental principles of the doctrine. We do not, therefore, advert to Mr. Earle personally, but merely as the representative of an important hypothesis.

That part of the doctrine which regards the essential condition of the vessels immediately concerned in the process of inflammation, supposes,

1st. A passive relaxation of the vessels, a suspension of their natural action when they are supposed to possess any, and an increase of their diameters.

2nd. A progressive accumulation, stagnation, and coagulation of the blood within the vessels.

It may be proper to state here, in the language of others, a summary of the whole doctrine, as we believe it to be generally received.

"The observation," says an enlightened writer, "which I have quoted from M. Gendrin, when taken in connexion with the facts previously stated, simplify the theory of inflammation, and satisfactorily explain the alliance of all its leading phenomena. The initiatory effusion of serum and lymph, dependent upon the visible obstruction of the circulation; the lymph with attenuated inflammatory fibrine; the consequent occasional mixture of blood with lymph; the formation of pus, secondary to and later than the secretion of serum and lymph, being the result of protracted inflammatory action; the solid particles in pus, although larger, yet of the same remarkable figure with those of the blood, and doubtless the same enlarged; the occurrence of blood in pus mixed with it in streaks, or generally diffused through it; the organization of lymph by extension of vessels, some at first containing pus, others a thick red liquid; and, lastly, inflammatory gangrene, proceeding from the vessels being, in certain cases, irrecoverably obstructed; are phenomena which may be declared to be now grouped under one law."†

By another it is said, "the circulation is completely interrupted in inflammation, the blood coagulates, clogs the vessels, &c."‡

We believe that all of this school concur in saying, that the vessels become more and more obstructed with coagulated blood as inflammation advances, and less and less capable of any independent action.

3d. Besides the foregoing conditions, there is an enlargement of the collateral vessels, proportioned to the redundancy of blood transmitted to the part, occasioned by its presence and the force of the vis a tergo.

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* London Medical Gazette, Vol. XVI.

† Mr. Mayo's Outline of Human Pathology, p. 431.

‡ Cyclopedia of Pract. Med. Art. Inflammation, p. 713.

4th. That the blood is propelled through the collateral vessels by the action of the heart; though all do not assent to this proposition.

5th. The vessels being thus paralyzed in their action, and mechanically obstructed, can perform no part in generating the products, or in what have been called the terminations of inflammation; and thence follows the corollary which is peculiar to Mr. Earle.

It is due to ourselves to premise, that we are fully sensible of the responsibility we have taken; and, that whatever we may say, irresistibly flows from the nature of our argument and from no disposition to offend where it is our highest ambition to entertain the most profound sentiments of respect. "It is not so much the present writer who speaks as the facts themselves."

It appears to be universally admitted, that in parts which carry red blood, a preternatural quantity is transmitted in inflammations, either through the vessels inflamed, or through the collateral vessels. This has been demonstrated by Mr. Lawrence.*

It is, also, candidly admitted by a strenuous advocate of the new doctrine that,

> "In opposition to the hypothesis of direct debility of the vessels, the exciting causes and treatment of inflammation coincide better with the idea of excessive, than of defective action."†

That a preternatural quantity of blood circulates through the diseased vessels appears from many facts. The most familiar is the profuse hemorrhage which often follows the application of leeches to an inflamed surface, and its florid colour. Objections have been made by many physicians to scarifications in erysipelas, on account of the great hemorrhage to which they are liable. In phlegmon the blood flows from incisions with increased force. If the blood of an inflamed part be expelled by rubbing, it will return with unusual velocity. The preternatural generation of heat is, also, another proof of our conclusion.

A passive dilatation of the vessels, supposes a cause that facilitates the transmission of blood. Nor is there any obstacle surmised that shall either counteract the effect of the enlarged diameters, or oppose the circulation before that enlargement takes place.

Concurring, also, with the foregoing cause in promoting a free circulation of the blood, is the more attenuated state of this fluid in inflammations, and its diminished tendency to coagulate.

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*On Diseases of the Eye, p. 64.

†Cyclopedia of Pract. Med. ut supra.

But, it is said, in opposition to mechanical laws, upon which the theory mainly rests, that the blood stagnates in the enlarged vessels, and this in proportion as their diameters become increased, although the blood is urged on by an increased force of the vis a tergo. It is then said to undergo coagulation; for it must first stagnate before coagulation can take place; notwithstanding, also, that the blood may be not only thinner than natural, but less disposed to coagulate.

This, however, is only the beginning of the conflict of the mechanical laws. There is a preternatural volume of blood determined towards the seat of inflammation; sometimes at least thrice the usual quantity. This is said to find its way through the collateral vessels. Of course, it must begin to enlarge these vessels before stagnation commences in the diseased vessels; otherwise, the diseased vessels, being passively dilated, would permit the redundant blood to follow their channel, and no stagnation could happen. Besides, it is distinctly denied that any redundant blood passes the diseased vessels at any time; whilst it is admitted that the volume of blood determined towards the inflamed part is increased from the beginning.

But suppose the stagnation begins first in the dilated vessels. The philosophy, then, will be scarcely any better; since in either case, the dilatation of the diseased vessels must be supposed to constitute an obstructing cause to the circulation. In the latter instance, it is true, the stagnated blood is a cause superadded to the enlarged diameters of the diseased vessels. But this hypothesis supposes, also, that the superadded cause must be adequate, in connexion with the former, to overcome the resistance that is opposed by the tonic and elastic properties of the collateral vessels, and thus enable the increased volume of blood to dilate and force its way through the vessels that are strongly contracted by their natural forces.

The process of inflammation, according to the theory which we are examining, appears not to have been traced beyond its primary stage, until Mr. Earle took up the principles on which the doctrine is founded, and explained the manner in which the various results take place. It appears to us, as we have intimated, that Mr. Earle's exposition is in perfect conformity with the laws that are supposed to operate in the introductory stage, and that the whole theory is perfectly consistent and unavoidable in all its parts.

It is, therefore, contended that serum and lymph arising from inflammation, are mere exudations from the blood; and as to pus, Mr. Earle thinks that "the opinion of its being a secretion cannot be admitted without carrying our deference to Mr. Hunter's authority to an unwarrantable extent."* And since the laws of life have no connexion with the formation of pus, it probably consists of some component part of the blood; and this is consistently supposed to make its escape in a purely mechanical manner.

Mr. Earle has illustrated this subject by comparison.

"Would it be a matter of astonishment," he says, "if the several parts of a fluid like the blood upon being pressed through an excessively fine sieve, were to come through in the order of their fluidity; that is, the finest and most fluid first, and the largest and coarsest last."†

Lest this hypothetical illustration might seem to be conclusive, we have seriously put it to the test of experiment. But every species of the finest texture, which was permeable by the serum, admitted, also, the passage of the red globules.

But we have seen that the vessels are clogged up and rendered impermeable, at least to the grosser fluids, by coagulated blood; and without a chance, from the want of vital action, of relieving themselves. This must be especially the case considering

"The impossibility of detecting any pores, or openings in the sides of the minute real vessels, the impossibility of the processes of nutrition and absorption being carried on through the coats of the vessels;" and, that "there are no new vessels formed, nor any new disposition of the old, which can be termed glandular."‡

In this condition of the vessels, therefore, it is difficult to understand how even so thin a fluid, as serum, should find its way from the extremities of the vessels, especially in any remarkable quantity. We might, perhaps, draw for our conclusion upon analogies in more precise sciences. For instance, if we stop up the end of a tube, the water can no longer make its escape. But we do not wish to go beyond the phenomena of living matter.

But besides this mechanical obstruction, the effusions, as well as the hypothesis, have to contend with other obstacles. In a wound "there is a thin layer of parenchyma," it is said, "between the external air and the blood in the subjacent vessels, which is sufficiently dense to prevent the egress of blood as blood; but it cannot prevent its exuding in detail." Then it is hypothetically stated, as we have seen, that the parts of a fluid, like the blood, upon being pressed through an excessively fine sieve, would come through in the order of their fluidity, the finest first, the coarsest last. But we have already shown, that although this be true in respect to a sieve, and the object for which it is employed, it does not hold good in regard to the blood. Could we have endowed our sieve with the laws and actions of life, we have no doubt that we should have made out the parallel. The conclusion, therefore, was forced upon us, that the simile is defective from the defect of the sieve in those endowments. But we leave this matter to be settled by farther experiments, and pass on to other difficulties.

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* London Medical Gazette, Vol. XVI. p. 136.

† Op. Cit. p. 141.

‡ Mr. Earle, ut supra, pp. 8, 142, 168.

After the serum has strained its way by the force of the heart alone, as is also stated, through the vessels that are clogged up with stagnated blood and the external layer of parenchyma, and whilst also, according to the doctrine, the blood has become still more stagnant in the extreme vessels, coagulable lymph, a much grosser part of the blood, begins to follow its pioneer. But here we think the order should have been reversed, if mechanical philosophy is to resolve the phenomenon.

"The surface," it is said, "now becomes covered with an amorphous deposition of coagulated fibrin, and becomes thicker, so that a greater impediment exists to the extrusion of the globules than before." But it forms no impediment to the globules of pus; for it is said, "the fluid now becomes thicker, and assumes the appearance which is known by the name of pus."*

And notwithstanding all these increasing obstacles, purulent matter is often poured out in a torrent, altogether exceeding the primary effusions of the more attenuated parts of the blood. Indeed, the size of the globules of pus, which are stated by many to be greater than the red globules, though not so considered by Mr. Earle, and the increased thickness of the stratum, are supposed to facilitate their escape.

"There are two reasons," says Mr. Earle, "why the globules are the last to be effused upon the surface of a wound. The first is to be found in their size, the second in the deposition of lymph, by which the thickness of the stratum through which they have to pass is increased." And again it is said, "the passage of the blood to the central point of the inflamed part, which was at first perfectly free, now becomes gradually *more and more* obstructed and difficult. As this happens, the globules lose their colouring matter in passing through the tissue thus thickened."†

But what strikes us as a far greater defect in this application of mechanical principles, is the arrest of the serum, or "finest and most fluid part of the blood," after "the largest and coarsest" parts have opened a channel for themselves. It should be also recollected that M. Donné has ascertained that the globules of pus are twice the size of those of the blood;‡ and this *analogically* should be the reason why the globules of *blood* do not make their escape.

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* Mr. Earle, Op. Cit. pp. 141, 142.

† Op. Cit. pp. 142, 188.

‡ Archives Générales. Août. 1836.

Again, following up the idea suggested by the sieve, Mr. E. accounts for the removal of the colouring matter from the globules of blood in their conversion into pus, upon the ground that, "it is certainly possible that it may be merely mechanically wiped off in their progress;" and this opinion is variously enforced.[*] But it will have been seen that this is contradicted by our experiments, notwithstanding we employed almost impermeable sieves and strainers, of incomparably greater firmness and resistance than the capillary blood-vessels.[†] It should also be considered that effusions of pus sometimes continue for months and for years.

How far friction can operate in the way supposed, may be inferred from Leeuwenhoek's estimate, that a globule of blood is only equal to $\frac{1}{25000}$ part of a grain of sand; and, that by Haller's, Wollaston's, Kater's, and Young's measurements, it would take about 10,000,000 of globules to make a square inch. Hewson saw thousands of them in an insect whose entire bulk did not exceed a pin's head. It should be recollected, too, that this wiping by the blood-vessels is contradicted by Mr. Earle's own showing; since, in rejecting entirely Mr. Hunter's theory of absorption and ulceration, he supposes that the surrounding tissues are broken down by the force of the vis a tergo;

> "The *first effect* of inflammatory infiltration being to destroy the original firmness and tenacity of every tissue in which it occurs, so as to cause it to be readily broken down and give way upon the *slightest pressure.*"[‡]

It is, therefore, the more difficult to imagine that degree of mechanical resistance or friction that must be necessary to detach the colouring matter from the globules of blood. And here we may remark, that since the vis a tergo is sufficient to break down all tissues, and is thus supposed to force an abscess to the surface, it is not a little singular that such a power should not occasionally force some of the red globules into this unresisting matrix.

But if the colouring matter be wiped off, as supposed, what should prevent each succeeding globule of pus from *pushing it out of the vessels?*

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[*] Op. Cit. pp. 142, 188, 219. This is analogous to an opinion entertained by some, that the absorbent glands supply the central particle of the red globules, by straining it off from the lymph or chyle.

[†] According to Sir E. Home, the colouring matter is easily removed. But he made no experiment. The colouring matter was manifestly washed off by the moisture that collected upon the sustaining glass. (*Philosophical Trans.* 1818.) Besides, it has been shown by Hodgkin and Müller, that the colouring matter is only disposed to leave the globules when water is applied. (*Pogendorf's Annals, T.* 25, *p.* 513.)

[‡] Op. Cit. p. 189.

Suppose, however, that Hodgkin, Liston, and others, are right in their statement that the globules of pus are formed from a gelatinous fluid that is first effused, it would be equally fatal to the hypothesis we are considering.

It appears to us, that not only the exclusion of the red globules from the suppurating vessels, but also from the serous and lymphatic vessels, may be most philosophically explained upon vital principles. In the first place, according to Leeuwenhoek, the size of the globules of blood are only $\frac{1}{23000}$ part of a grain of sand, or *thereabouts.* It is impossible to imagine the existence of vessels so small. In another, and more exact science, they would be called "mathematical lines." We must, therefore, seek for another principle which shall explain the exclusion of the red globules from vessels of a greater diameter. This is to be found in the different modifications of their irritability, in Haller's and Hunter's sense of the word; just as it is manifested in the elective function of the excretory vessels of the liver, kidneys, &c., and as seen in the refusal of the lacteals to take up bile.

By others it is contended that the introductory stage of inflammation is simply one of congestion;

> "Characterized, first, by an increased activity of the vessels and influx of blood, various degrees of turgescence, &c.; and secondly, as the congestion increases, a laboured, slow circulation arising from the over-distension of the vessels, and an increased thickness and viscidity of the blood."

It might be supposed that this state of vascular turgescence, and whilst the blood is yet fluid, and the vessels possess an increased action, would be most auspicious to the various effusions. But it is not so considered.

> "The period of inflammation," the writer continues, "is characterized by an entirely new order of morbid changes. The circulation is completely interrupted, the blood coagulates, clogs the vessels; some of the vessels are ruptured, and there is an extravasation either of blood or of coagulated lymph in the parenchyma; lymph and serum are also exuded, and the deposition of the new products leads to a decided change of structure." New vessels then appear which are said to be "mechanically formed."*

This writer, however, appears to adopt M. Gendrin's explanation of the formation of pus, which to us is unintelligible, considering the existing state of the vessels.

> "After the inflammation," he says, "has attained its height, the circulation remains for some time stagnant, the vessels and intermediate cellular texture being both filled with coagulated blood and lymph; the colouring matter gradually disappears, the part assuming more and more an opal tint; small,

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* Cyclopedia of Pract. Med. Art. *Inflammation*, p. 713.

yellow soft molecules may be seen interspersed through the coagulum, and some of them agglomerating in large globules evidently purulent. A slow degree of motion gradually becomes apparent by the oscillation of some of the globules in some of the vessels; whilst a passage seems to be made for others through the softened lymph by the formation of new vessels, especially near the surface."*

M. Gendrin, however, very justly supposes that in this state of the vessels there can be no vital action, and ascribes the formation of pus to a mere mechanical change of the blood, although we do not learn from him the philosophy of the change, nor how the blood begins to move, nor how the pus, all at once, makes its escape in such prodigious quantities from vessels so blockaded up with coagulated blood, and so destitute of all independent action. But in less embarrassed states of the vessels, he thinks that pus depends upon a vital process, and that it is then "une véritable sécrétion morbide."†

Nor do we see that Professor Nauman's explanation does more than confirm the difficulties.

"The physiological rationale of the developement of inflammation," says this gentleman, "is briefly as follows. The blood accumulating gradually in the capillary vessels, owing to the congestion in a part, becomes more and more a source of abnormal irritation to the nervous ramifications. The globules of blood become more and more crowded together. Owing to the impeded motion of the blood, its fibrine, (*from its organic affinity to the cruor,*) will be most easily held back, whilst the rarer parts of the fluid still find their way into the venous stream. When the increasing stagnation ceases to admit any of this, the serum of the blood at length penetrates the coats of the capillary vessels, and collects itself within the cellular texture, in the shape of what has been called puriform serum. At the same time the fibrine and the globules are retained in close conjunction with each other in the capillary vessels."‡

How the coarser fluids ultimately escape, does not appear in the journal from which we have made this extract. But Mr. Earle, and others, state that inflammation does not decrease with the suppurating process; that Mr. Hunter was wrong in considering this process a termination of inflammation, and that, of course, the vessels remain obstructed as usual. And this is perfectly philosophical. For, if stagnation and coagulation of blood were necessary to the first effusion of pus, it must be equally necessary so *long as this product continues to be formed*, however enormous may be the discharge.

We now come to that part of the doctrine of inflammation, which expounds the philosophy of the removal of parts interposed betwixt an abscess and the surface, and which explodes Mr. Hunter's theory of the agency of the absorbents.

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* Ibid. p. 716. † Hist. Anatom. de Inflam., T. 2nd. S. 1461, 1463, etc.

‡ British and Foreign Medical Review, No. 5, p. 214.

This hypothesis ascribes the phenomenon to the previous results of inflammation, and the forcing power of the heart, by which all surrounding tissues are broken down; although it is not shown how parts that disappear in this process are removed.

"As the course of the blood in the capillaries," says Mr. Earle, "is, generally speaking, from the centre towards the circumference, such is the direction of the *vis a tergo*, and such must be the usual course of the pus. It cannot penetrate from the circumference towards the centre, because there is no force by which it can be impelled in that direction." "The first effect of inflammatory infiltration is to destroy the original firmness and tenacity of every tissue in which it occurs, so as to cause it to be readily broken down, and give way on the slightest pressure; bone, cartilage, fibro-cartilage, are all affected alike." "It is evident, that although there must be a general yielding over the whole of the inflamed part, it will be most decided precisely at that point upon which the greatest degree of pressure is exerted."*

This would certainly appear to be the only solution that the new doctrine of inflammation will admit; and it has the consistency of adhering to fundamental principles. But a strong exception to the hypothesis must be fatal to it. In peritoneal inflammation the force of the *vis a tergo* is as much towards the cavity of the abdomen as the surface of the body; and yet when suppuration takes place, the matter penetrates through fascia, muscle, and skin, although the peritoneum is the only obstacle to be overcome in the other direction. We may also suppose that the downward and increasing pressure of the accumulated matter is quite equal to the *vis a tergo in the capillaries;* especially as the latter, according to the new theory, is generally supposed, and particularly by Mr. Earle, to depend wholly upon the heart. The same reasoning is applicable to many other parts, where the force of the vis a tergo is directed as much below an abscess as towards the surface. A striking instance exists in abscesses of the liver.

As to the manifest agency of the absorbents, it is not more remarkable that their operation should be restricted to the anterior wall of an abscess, than that they should be limited to the absorption of chyle in one part, or that blood should be excluded from the whole. We cannot interrogate nature as to the insensible principles upon which her vital phenomena depend. We must be content to know the results, and through them to infer the existence of laws as indispensable to the phenomena, as the soul is to thought or to voluntary motion.

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* Op. Cit. p. 189.

But we can imagine that a reason for the greater activity of the absorbents of the anterior parietes of an abscess may be found in the greater activity of inflammation in this part; whilst some tissues, especially the serous, are little liable to ulceration. Mr. Hunter is certainly ambiguous, when he ascribes the progress of an abscess towards the surface to a species of intelligence. Still it is a figurative explanation. He appears to have been sensible of the philosophy, that the process is the result of a general law, by which inflammation is more readily excited, and ranges higher in superficial parts, than in the deep seated. In virtue of this law, the anterior walls of an abscess more readily inflame and ulcerate than the posterior.

We come next to the granulating process; and this should be as much a mechanical one as the antecedent. Accordingly, it is said,

> "The same extreme simplicity reigns in this as throughout every preceding part of the process of inflammation." "It is as easy to explain the whole process of ulceration and mortification, as it was to account for the opening of an abscess, without even hinting at the existence of the lymphatic system."

And with scarcely more than this simple declaration, the all important subject of absorption is dismissed; it being considered

> "Unnecessary, and would be *very inconvenient*, to inquire into the foundation of Mr. Hunter's opinions on the subject of absorption in this place."[*]

> "As the fresh fibrine exudes through the original layer by the channels or perforations, it will coagulate around them in little heaps."[†]

But we are not told how it happens that fibrine, or the granulations, all at once make their appearance after an indefinite continuance of the suppurating process. It is stated that "there can be no essential difference between suppurative and ulcerative inflammation."[‡] But there is certainly this manifest difference in the results, as the terms are here employed, that pus is formed in one case and granulations in the other; that one is a destructive, whilst the other is a restorative process.

But suppose, instead of a healthy granulating ulcer, we look at a destructive one,—such as the syphilitic or cancerous. How, we would ask, is the removal of parts effected in such instances; and why are not granulations formed as in the other case? Why is it often necessary to employ constitutional and local remedies, sometimes mercury, and sometimes lunar caustic, to promote the deposition of coagulable lymph? How are the supposed mechanical laws affected by these agents?

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[*] Mr. Earle, Op. Cit. pp. 218, 250. As to the absorbing power of the veins, it is still *sub-judice*.

[†] Ibid. p. 219.

[‡] Ibid. p. 222.

From whatever parts of the body granulations may spring up, they have all originally the same appearance. The same in bone as in muscle. But they are ultimately changed into the nature of the tissue from which they proceed. We know not the cause, but we see the effect; and this effect assures us of a specific action in the different granulations, accounts for the difference in purulent matter, as well as its general specific nature, and derides every attempt to solve the mystery by chemical or mechanical laws.

Dr. Johnson has shown by the most plausible analogy, that if the growth of the body depend upon vital action, so also must the formation of granulations.*

Finally, we come to mortification. And here we must not be surprised, having hitherto so entirely lost sight of the vital powers and actions, that they are allowed no part in the curious process that attends the separation of the dead from the living substance. The vis a tergo, the heart alone, from the beginning to the end of inflammation, is the only agent by which all the phenomena are carried on. But, it is said,

> "The separation of the dead from the living parts has, since the time of Mr. Hunter, been supposed to be performed by the agency of the absorbing vessels; nor does any one, so far as known to Mr. Earle, doubt the correctness of this branch of Mr. Hunter's favourite doctrine."

We are told, however, that the absorbents have no more to do with it, than they have with the process of ulceration. And the same reason for rejecting the absorbents that was before stated, is here repeated, viz: because "a full and complete explanation of every circumstance connected with mortification can be given, without even alluding to the existence of the lymphatic system."† If nothing can be easier or more simple, certainly nothing can be more consistent. Fluids, as we have seen, are effused.

> "The first effect," it is said, "is that of destroying the natural tenacity of the solids, of rendering them, as it were, rotten, so as to be easily broken down by the slightest pressure. Of course, this effect must be most apparent at the point where there is most effusion, which must be exactly where the living touches upon the dead part. Thus it happens that the force of the vis a tergo, by whose pressure the effusion of the different parts of the blood is effected, impinges precisely upon those points which are the weakest and most likely to give way; by which means the dead part is gradually detached from the living, and, as it were, washed off by the discharge."‡

Since we have endeavoured to show that the doctrine of pressure, as applied to ulceration to explain an analogous process, is not only deficient, but contradicted by facts, it may be considered equally groundless as it regards mortification. There is nothing more marvellous in the supposition that dead parts may so stimulate the absorbents, whose action is already modified, and thus prepared by a specific condition of disease, to remove the contiguous living parts, than there is in any other vital phenomenon.

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* Med. Chirurg. Rev., Vol. XX. p. 227.

† Op. Cit. p. 250.

‡ Page 250.

But it is important to recollect that the vessels in mortification are supposed to be more than ever obstructed by coagulated blood, and that it is in virtue of this accident that the part dies. The adjacent sound part is also inflamed, and its vessels, of course, greatly obstructed. It does not, therefore, so clearly appear how the forcing influence of the heart is to reach the sloughing part.

We might go on to illustrate this subject by analogies drawn from the vegetable kingdom; and inquire how far the removal of their sloughing parts depends upon the mechanical action of the *vis a tergo;* how far their reproduction upon chemical or mechanical laws, &c.; and, lastly, we might show that one theory has been built upon another, to account for the precise, yet diversified and unique phenomena of inflammation.

As to the cause of mortification, we need not the aid of the mechanical doctrine, excepting so far as circulation ceases when the part dies. It is as easy to understand how the life of a part may be destroyed by the alteration of its powers and functions, which constitutes disease, as to comprehend the manner in which constitutional fever extinguishes the entire life of the body. There is something, indeed, in the rapidity with which decomposition sometimes goes on in mortification from inflammation, as in erysipelas and morbid poisons, that is without any analogy in chemical philosophy, and which can only be explained, if we may hazard the expression, upon vital principles.

In having thus endeavoured to sustain the doctrines of Mr. Hunter, we certainly do not recognise a *vis medicatrix nàturæ* in the sense in which it is ridiculed by Mr. Earle and others; nor do we think that the construction which is forced upon those who adopt it is justified by fair interpretation. Provident nature has so ordered many of the actions of disease, that they shall ultimately terminate in a sanative process; and instead of the interposition of any latent and mysterious agent, the ultimate result is brought about by the same vital powers, and by the same instruments that had been engaged in the morbid process.

"The good God that created the animal stamped upon his organization a tendency to actions, and a power of originating them, adapted to the repair of a certain amount of injury."*

This, we believe, is all that medical philosophers of the present day intend by the *vis medicatrix naturæ;* a figurative term, we admit, that ought to be hunted down, but should not carry with it those who employ it for mere convenience.

We perfectly agree with Mr. Earle, that "although the progress of improvement may be for a time retarded by too great a deference to authority, it is impossible that men's minds should remain impervious to the direct evidence of simple facts." But should it be otherwise, and the mechanical doctrine of inflammation ultimately prevail, then every process of the living body, whether morbid or healthy, must be construed by the same rule; unless, perhaps, a different principle must be necessarily admitted to preside over the heart, just as the materialist is forced to the recognition of consciousness. We make every allowance for the obliquity of unbelievers, and are even content that the whole subject of inflammation shall be tested by those mechanical laws which our friends have assumed as its foundation.

Another observer, despairing of light from the "*contractions* of any of the solids," thinks we ought rather to look for it "in the state of the attractions subsisting during the living state among the particles of the blood, and between them and the surrounding solids."† But here, too, we are willing to leave the explanation to the mechanical laws.

We have now seen that the doctrine of passive relaxation of the vessels, and the consequent stagnation and coagulation of blood, can never explain, and is even opposed by, the phenomena of increased heat; throbbing in the immediate instruments of disease, when the force of the heart is not increased; the greatly increased volume of blood circulating in these instruments, and its general increased fluidity, urged on, too, by an increasing force of the vis a tergo; the augmented force with which the blood escapes from the vessels, when divided, showing not only an undisturbed circulation, but a positive action of the vessels themselves; the remarkable varieties of inflammation, and their peculiar products; the effusion of serum, lymph, pus, and finally, of blood, especially in the inverse order of the respective diameters of their globules and the diameters of the vessels; the exclusion of the more fluid parts, whilst the grosser alone escape; the disappearance of the colouring matter from all but the globules of blood; the extraordinary processes of ulceration, reproduction and sloughing; and, finally, the causes and curative means of inflammation.

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* Dr. Johnson in Medico-Chirurg. Rev., Vol. XX. p. 328.

† London Med. Gazette, Vol. XVI. p. 741. So, also, Dr. Hall in his Principles of the Theory and Practice of Medicine.

On the other hand, whilst the foregoing doctrine leaves nothing to the vital forces and actions, these are capable of explaining every phenomenon of inflammation.

We shall now notice an experiment lately made by Professor Allison, since it is supposed to be an *experimentum crucis.* To ascertain whether "the arteries leading to an inflamed part are really endowed with a greater vital power of contraction than sound arteries," Prof. A. at different periods after killing the animal, compared the vessels of the inflamed limb with the corresponding ones in the opposite sound limb. At the moment of death, the artery leading to the inflamed part had contracted less than that of the sound limb. At a second examination, sixteen or twenty-four hours after the first, the artery in the inflamed limb still remained larger than the other. That of the inflamed limb retained a considerable quantity of blood, whilst the other was almost empty.* Here is no room for mistake, no microscope, no vital forces to be equivocally explored. We cannot think, however, that the experiment proves any thing more than that the arteries contract after death, as we have always believed, mainly by virtue of their elastic property. This property was impaired in two ways in the morbid vessels; by the diseased state of the vital forces, and by the interstitial deposit in the dilated vascular parietes. Indeed, it was a part of the experiment to prove that the elasticity of the artery of the inflamed limb was impaired.†

Dr. Poiseuille thinks he has proved by experiments, that "the heart and elasticity of the arterial coats are the sole agents in capillary circulation;" and this has been often assumed in support of some hypothesis. But however the phenomena of nature may set these experiments aside, we have as little doubt that the elasticity of the vessels is impaired by inflammation, as that their vital forces are increased by that mode of disease, or immediately so extinguished by death as to render them inoperative in the natural condition of the body.

From the foregoing experiments a new hypothesis comes up; that the vessels in inflammation are not only in a state of relaxation, but that there is an increased action by which the blood is moved in the capillaries of the part, resulting from powers inherent in the blood itself, and independent of any contraction of the blood-vessels, "the action being not *in the vessels, but within the vessels.*" This principle has been supposed by many to appertain to the blood since the time of Harvey and Haller; but it is now asserted that it is increased in inflammation. The increased exertion of the powers of the blood leads to distension, and a diminution of the tonicity of the vessels. How far this may be a matter of speculation, or inferable from facts or from reason, we shall not attempt to show. It certainly is not supported by the sluggish motion of the blood in inflammation, which its advocates also profess.

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* London Med. Gazette, Vol. XVI.

† Even in the natural state of parts, elasticity is evidently modified by the laws of life.

The general hypothesis is, that the blood, at least in the seat of inflammation, is moved alone by the force of the heart. We have lately seen a writer maintaining that the increased action of the heart is owing to a mechanical cause; that,

> "As every point of stagnation offers a point of increasing resistance, it follows as a mechanical consequence, that the impulson of the recoil must return to the heart as the original instrument of the propulsion, by which it is excited to stronger and more frequent contractions."*

But will this explain the phenomena afforded by the familiar example of a whitlow, as stated by Mr. Hunter? Do we not constantly find the larger vessels, proceeding to an inflamed part, pulsating with violence long before the action of the part becomes affected? How often does it not happen in coexisting inflammations and venous congestions of the brain or abdominal viscera, and where the action of the heart is prostrated by the latter form of disease, that the carotid and abdominal arteries beat with extraordinary energy, "quod pulsatio in præcordiis manifestat?"† φλεϐῶν σφυγμοὶ παρ ὀμφαλὸν.‡ How, too, will the foregoing doctrine explain the tumultuous action of the heart in many cases where no inflammation exists, when induced by excessive abstractions of blood, &c? If the vital laws are to expound the phenomenon in all other cases than inflammation, it appears not unphilosophical to admit the operation of sympathy in this instance. Besides it is the well known effect of unusual determinations of blood upon the heart to embarrass its action and lessen its force.

We do not expect to demonstrate the actions of the extreme and almost invisible vessels, more than we do the vital powers upon which they depend. We are allowed to infer the existence of the latter from the phenomena; and we see not why the results that appertain to the capillary system, or rather to the extreme vessels, are not as good evidence in proof of the former. And why are these minute vessels so eminently endowed with the vital forces, unless for the performance of some specific functions; and can those functions take place without some independent action?" We see the same powers modified in inflammation, and other diseases, and this is, therefore, a strong ground for belief that there are corresponding modified actions. It may be, that in the larger arteries no such action exists, since they are designed as conduits through which the blood is propelled by the heart, and appear to have no other final cause. But in the extreme vessels we see a vast variety of specific phenomena taking place, and it is only here that we witness the principal manifestations of the vital properties.

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* Weatherhead on Diseases of the Lungs, p. 19.

† Aretæus, De Acut. L. 2, c. 8.

‡ Hippocrates Morb. Poputor. L. 4, ver. 129.

If the vessels in inflammation be actually weakened, passively dilated, clogged up with coagulated blood, when does their tone return, and by what causes is it re-established? If by the vital forces, when and how came they again into operation?

It being supposed that the vessels are weakened in inflammation, it has been necessary to assume that the causes are debilitating; and it were well that the subjects, also, should be amongst the feeble instead of the robust. It seems, however, to be generally in all respects otherwise. For instance, pneumonia affects mostly the robust and plethoric. Cold, when suddenly applied, is one of its exciting causes, which, in its ordinary operation, is tonic. Stimulants and direct tonics are other causes of inflammation. But if the causes be really debilitating, the remedies should be invigorating; and these, therefore, consist of blood-letting, cathartics, tartarized antimony, &c.

We shall close these remarks with an argument in favour of the Hunterean theory of inflammation, drawn from the nature and formation of pus. If it can be shown to differ from the component parts of the blood, or to depend on a secretory process, it would appear to substantiate an independent action in the instruments of inflammation.

Mr. Earle, and the friends of the new school of inflammation, find it necessary to identify pus with a component part of the blood, and to explain its formation upon mechanical principles.

They contend that neither inflammation nor pus being met with in the healthy system, pus is not, therefore,

> "A healthy secretion;" and "it is as little entitled to be called a morbid secretion, because by this term is understood some change or deviation from that which is usually recognised as the healthy condition of a secretion. The term morbid secretion, therefore, applies to black bile, and to diabetic urine; but no to pus, which is an entirely new formation."*

This would appear, as we have said, to follow from the new doctrine of inflammation. For secretion is a process that depends on an active state of the vessels. But since the vessels are relaxed and encumbered with coagulated blood, it is reasonable to conclude that pus depends upon some other function more compatible with such a state of the vessels, and that, therefore, it is not a secreted fluid.

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* Op. Cit., p. 137.

But there is nothing to show, save the objection we have stated ourselves, that new formations may not be as purely the result of a secretory process as bile or urine. We do not see the logic of the foregoing conclusion. Man may bestow names upon natural phenomena; but in excluding analogous ones that may depend on a new condition of the powers and functions of the body, he must show their incompatibility with those laws of vitality upon which the natural phenomena depend. If there may be a morbid state of action, it seems very philosophical to suppose a morbid secretion. We cannot otherwise reason from analogies supplied by the healthy system, to diseased states of the system. In the latter case the modified power must be regarded as performing new functions. New products, therefore, may arise; and however we may choose to restrict the term *secretion* to healthy products, it does not follow that the morbid ones, although wholly new, may not be equally entitled to that appellation.

But do we not find in the very argument that is urged against the formation of pus as a secreted fluid, an illustrative fact that it is really the product of morbid secretion? It is admitted that there may be morbid bile, depending upon a morbid process. Now healthy bile is one thing, and morbid bile another. One action is natural, the other unnatural. Morbid bile has no more existence in the healthy system than pus, and it cannot take place without the morbid process. We see not, therefore, why, in a uniform modification of the vital powers and functions, as in common inflammation, the natural secretions of the parenchymatous capillary arteries may not be, in like manner, changed into pus. Mr. Earle and his friends consider pus the nucleus of the red globules, and that nucleus is supposed to be coagulable lymph. And yet it is maintained that pus is a new formation.

But, if it be still insisted that pus is wholly a "new formation," we ask for the proof that such formations do not depend upon a secretory process. An assumption has been made, and a syllogism invented to sustain it. But this cannot pass in opposition to a better syllogism; and, as we believe, to direct and unquestionable facts that are supplied by analogy, as well as the laws that govern the living body. Does bone ever form in the healthy membranes of the brain; melicerous, steatomatous, carcinomatous, hæmatodic, and other specific products, take place in any part of the body without specific conditions of disease, and that disease in all probability, of an inflammatory nature? And will it be denied that these are the result of a secretory process?

Upon the hypothesis just quoted, we might, also, equally argue that pus is not separated mechanically from the blood, since such a phenomenon never occurs in the healthy system; and it is not pretended that its mechanical origin is supported by any analogy in disease.

Again, it is said,

> "There is this essential distinction between a secretion and pus; the products of the secernent function are different in every membrane, texture, and organ of the body; mucus is secreted from the blood in vessels of mucous membranes, &c.; whilst no such variety is observed in the formation of pus."*

Admitting the latter statement to be true, we cannot see the force of the analogy. The liver secretes bile; the kidneys urine; the lachrymal, salivary, and cutaneous glands, produce tears, saliva, sweat, &c.; because the several organs are made up in a distinct and complex manner for this purpose. For this reason we should say, *à priori*, that the products would be different, and would vary in their composition according to the complexity of the organs. But in inflammation, it is not the glandular apparatus that is concerned, but the circulating, whose action must be supposed to be very similar in every part of the body. We should, therefore, in this case, also infer, *à priori*, that in the same conditions of inflammation, the products would be the same; that in one condition we should have serum, in another lymph, and in another always pus. And we may take from Mr. Earle, what he intended as an objection, another evidence that our conclusion is right. "As the blood is the same from whatever artery it is taken, and also, as inflammation is essentially the same, in whatever texture it may occur, the effect thereof must be the same in all."†

But we believe it is not true, that simple structures, which are admitted by our friends to perform a secernent function, do not have their natural products changed into pus by inflammation. Take the very one quoted above, by which the adverse hypothesis is sustained. Do we not often find, in inflammations of the mucous membrane of the lungs, that the secretion of mucus is converted into a copious effusion of purulent matter, and this too, where there is no ulceration of the membrane. The same fact may be affirmed of the serous membranes. That the liver never secretes pus, except in its nutritive and circulating parenchyma, is highly probable; for here the secernent apparatus is complex, the laws specific; and the effusion of bile, or, in the kidneys of urine, is a direct impediment to the formation of that kind and and degree of inflammation in the secerning apparatus, that are necessary to the formation of pus.

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* Mr. Earle, ut supra.

† Op. Cit.

> "The term secretion;" say our friends, "ought never to have been applied to the fluid which is called pus; for this term in its true signification is expressive of something which results from the operation of the nervous influence on the blood. Now it has already been shown that the secernent function of the nerves is put a stop to, in the very commencement of inflammation, of which pus is only one of the results."*

If we admit the latter proposition to be true, of which, however, we are hardly satisfied, except in cases where the nervous communication has been uninterrupted, we must certainly reject the former. It will then follow according to the foregoing reasoning, that since, as we shall show, the nervous influence is not necessary to the function of secretion in the natural state of a part, it is not necessary to it when the part is inflamed.

Now, we doubt not that the secretion of any complex organ, like the liver, or the kidneys, would be suspended or greatly diminished by cutting off the nervous influence. This influence is necessary to maintain a harmony of action amongst so many parts as are here concerned in the processs of secretion; and it is but reasonable to suppose that when this concert of action is violently disturbed, we shall witness some remarkable change in the natural product. It has been also most conclusively shown by Dr. Philip in more simple organs, as in the mucous membrane of the lungs and stomach, that the secretions of those organs are modified by a division of the par vagum, especially in the latter organ. But so far from the secretions being suspended in consequence, they are actually increased, and this constitutes the main peculiarity in the lungs. Nor can any appreciable change from the natural state of the mucous or the gastric juice be detected; whilst there may be, also, simultaneously induced a state of inflammation by dividing the nerve. "The lungs," says Dr. Philip, whose authority is so justly invoked in this matter by Mr. Earle and his school,

> "Are found after death *distended* with a frothy fluid, which filled the bronchia and air cells, and prevents the lungs from collapsing;" and as to the stomach, "it deserves notice, that although the eighth pair of nerves have been divided, the food is found covered with apparently the same semi-fluid which we find covering the food in *a healthy stomach.*"†

Here we are contemplating simple structures, though even less so than the apparatus of inflammatory action. We find the secretions at least not diminished by removing the nervous influence; and the only known change that takes place in those of the stomach is inferred from the food being undigested. The whole matter, therefore, is resolved into the simple fact, that the nervous influence is necessary, and only necessary, to impart to secreted fluids some unknown specific property that may be designed for some great final cause.

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* Op. Cit.

† Experimental Inquiry, &c., C. 5, S. 1.

It being thus shown that the nervous influence is not necessary to the function of secretion, in its general sense, the same process, *a fortiori*, may go on in inflammation and result in the formation of a new product. By the foregoing reasoning, also, if the nervous influence be suspended in inflammation, it is rendered more probable that a change should take place in the natural secretions of parts when inflamed; that instead of serum we should have lymph; and purulent matter instead of lymph and mucus; since it appears on dividing the par vagum, the gastric juice is so modified that it loses its property of digesting food.

It is also said, "that whilst the utility of every part of the secernent function is obvious, no one has been able to offer even a probable conjecture as to the use of pus."*

Here the implied analogy is obviously defective; since the final cause of healthy secretion must be clearly different from the morbid. As well, too, might we say, that vitiated bile, or diabetic urine, are not secretions, because their uses may be unknown. But if any final cause appertain to the secretion of pus, we shall no doubt find it bearing a strong relation to the curative means of inflammation.† And, accordingly, we find that it is actually instituted by nature for the removal of that mode of disease; as is most distinctly evinced in all suppurating phlegmasiæ. Who does not know that inflammation of the breast, of biles, &c., is greatly diminished as soon as suppuration has taken place? Just so, too, with dropsical effusions that follow inflammation. So entirely is the vascularity often overcome by the effusion, that physicians frequently declare that such cases have had no dependence on inflammation; and this, perhaps, in the very face of the most characteristic symptoms and the depleting treatment.

That such is the final cause of suppuration is rendered farther obvious by the subsequent beginning of the restorative process, or the process of granulation; which, indeed, never commences upon an exposed surface till a full suppuration has nearly removed the inflammation.

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* Mr. Earle. Op. Cit.

† Mr. Earle says, "it is merely the inevitable consequence of the original stagnation of blood." (*Op. Cit. p.* 190.) Perhaps it may be so, though it might be difficult to show that it is. But may not the same be affirmed of every cause and effect? It does not at all alter the question as to the modus operandi.

It appears, therefore, that only a low degree of inflammation is necessary to the formation of pus, or a morbid secretion of serum; and this may be maintained as well by the influence of habit as by other causes. Even the new granulations take on the suppurating action through the influence of sympathy.

But it appears, also, that purulent matter is not always the same, however some chemists may have been led to an opposite conclusion. This opinion has prevailed from the time of Hippocrates, who says of it, "pus vero optimum est album, æquale et læve, et quam minimum graveolens; huic autem contrarium pessimum." It was originally founded, it is true, upon the sensible appearances of pus, and upon the obvious differences in the state of the vital powers and actions in different cases. "There is certainly no obvious difference," (according to the microscope,) says M. Gendrin, "betwixt the pus of chancres and that of simple wounds or ulcers." But this shrewd and laborious philosopher candidly adds, that "it possesses *other differences* which elude our means of investigation."[*]

It appears, too, from a variety of facts, that pus is specifically different from any component part of the blood. The globules of pus are distinguished from all other animal fluids, with the exception of homogeneous blood, in being changed by sal ammoniac into a tenaceous jelly. This substance dissolves the globules of blood, and ultimately fibrine, whilst it has no such action on the globules of pus.[†] When pus is combined with blood, coagulation takes place in the usual manner; but the coagulum soon after becomes fluid.[‡] Pus precipitates in cold water, and according to Gendrin and others, the precipitate is equally globular as pus. "It appears, indeed, to contain a greater quantity of globules than fresh purulent matter.[§]

M. Donné considers pus a chemical product resulting from the action of an acid upon albuminous matter. With others he estimates the globules at twice the size of those of the blood, and considers them of a different shape and structure.* Hodgkin says "they bear no resemblance to those of the blood."† Sir E. Home,‡ and Mr. Liston,§ maintain that the globules are formed after the matter is secreted. M. Gendrin makes pus to depend, in the most obstructed state of the vessels, upon a mere chemical process, not yet well known; being then wholly independent of any vital influence of the inflamed part. In less embarrassed states of the vessels, he considers it a true secretion, and often speaks of it as "une veritable sécrétion morbide." At other times he thinks that extravasated blood may be equally changed into pus.‖ This is nearly the opinion of Mr. Key, who thinks, also, it may sometimes depend upon the breaking up of a tissue, and its gradual conversion into pus."¶ Dr. Carswell thinks it may be sometimes the result of vital action, and again of a spontaneous change of extra vascular blood."** De Haen,†† Andral,‡‡ and others, believe that pus, under certain circumstances, may form itself altogether in the blood.

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[*] "Cependant il présente d'autres différences qu'il n'est pas donné de reconnoître par nos moyens physiques d'investigation." (*Hist Anatom. des Inflam. T. 2, S.* 1473.) Again, "On conçoit qu'il peut y avoir des modifications nombreuses dans la facilité avec laquelle il est produit, purisqu'il tire évidemment son origine du sang qui peut être altéré de bien des manières, et qu'il est subordonné a l'existence d'une phlegmasie dans la partie ou il se forme." (*S.* 1468.) He states, also, many facts that lead to this conclusion, as seen in caries, scrofula, gout, &c., where chemistry shows a distinction in the component parts of pus.

[†] M. Donné in Archives Génórales, Août. 1836.

[‡] Ibid.

[§] Hist. Anatom. des Inflam. T. 2, S. 1472.

Nothing can be more incompatible with the common analogies of nature, or supply a stronger evidence that pus is a substance *sui generis*, and the propriety of looking to the vital forces for an explanation of its origin. If "the laws of physiology begin where those of the physical sciences end," it cannot be that pus is sometimes the result of a vital process, sometimes formed by the transmutation of solid parts, or again a putrescent or other chemical change of extravasated or intravascular blood.

Pus is said to resemble serum in its composition more than fibrine, and again it is considered identical with the latter, and by others with the nucleus of the red globules. But lymph coagulates spontaneously, whilst pus does not. Pus also evaporates to dryness, without coagulating, nor is it coagulated by oxymuriate of mercury. It precipitates from its solution in sulphuric acid, and it is precipitated by water from a solution in potass. Thus, direct analyses of animal products may not be always trusted.

"I have endeavoured to prove," says M. Raspail, "how deceptious re-agents are, as applied to a substance so complicated as the blood. Nature abounds in mixtures, whose study the chemist has not entered upon, and which might be capable of presenting on a small scale the appearance of blood."*

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* Ut. supra.

† Anatomical Catalogue of Guy's Hospital Obs. on Sec. 2, Part 1.

‡ Wilson on the Blood, &c. p. 291.

§ Elements of Surgery, p. 30.

‖ Hist. Anatom. des Inflam. T. 2, S. 1461, 1463, &c.

¶ Med. Chir. Trans. Vol. XIX. p. 142, &c.

** Illustrations of the Elementary Forms of Disease. Fas. 8.

†† Method Medendi. De Gen. Paris, T. 1, p. 60.

‡‡ Clinique Médicale, T. 4, p. 683.

Whilst a theory has been established upon the supposed abundance of iron in the colouring matter of blood, "Professor Brande has tried in various ways to detect the presence of that metal, but has always found the traces indistinct."† In opposition to others, he considers the colouring matter a peculiar animal substance. "It is remarkable," says Messrs. Brett and Bird, "that the experiments of Berzelius on the reactions of nitric acid on cruor are completely opposed to ours."‡

Dr. Davy§ states that there is little or no change of colour, on agitating venous blood with atmospheric air. On the other hand, Dr. Christison‖ avers that "the purple venous blood becomes brightly crimson, and remains so for more than a day." Dr. Davy says that hydrogen gas had the same effect as atmospheric air. Dr. Christison says it produces no effect. Dr. Davy proved, also, by experiments, that when air is agitated with venous blood, "its volume is not changed, nor its composition appreciably altered." He sometimes employed a pound of blood, and a flask of two or three gallons. Dr. Christison, however, has shown as conclusively, that there "is not that want of action on the air which Dr. Davy believes he has established," and that the common opinion is correct. Berzelius makes the solid part of chyle to consist of twenty per cent. of fat, and Raspail thinks it differs but little from milk. Prout and Turner, however, find in it only an appreciable trace of oily matter, and state that it wants only the red globules to complete its resemblance to blood. Again, chemistry declares no difference betwixt milk and sweet almonds, the latter being only milk in a solid form.

Dr. E. Thomson,¶ by digesting muscular fibre in muriatic acid, produced a substance "exactly resembling chyme;" whilst Dr. Davy** found that the putrefaction of muscle was attended by a like result. Chemistry also professes to show that the albumen of eggs and the product of certain cancers are exactly the same thing. Chemistry identifies starch, gum arabic, liquorice, sugar and vinegar. Its report is nearly the same in respect to pus, serum, mucus, lymph, and blood itself. We must suppose, therefore, that in one case, the elements and constituents are combined in peculiar ways by the agency of the

* On Organic Chemistry, p. 417. † S. Wilson's Lectures on the Blood, p. 40.

‡ London Med. Gazette, Vol. XVI., p. 754.

§ Edinb. Med. and Surg. Journal, Vol. XXXIV., p. 243.

‖ Ibid. Vol. XXXV., p. 94.

¶ Sixth Report of the British Association for the Advancement of Science.

** Edinburgh Med. and Surg. Journal, Vol. XXXIV., p. 264.

vital laws; in the other, that the combinations of the elements are equally modified by the laws of chemistry, if not of vitality, although we know nothing of the manner.

The farther, indeed, the chemist pushes his investigations, the more he multiplies proofs, that the whole subject belongs, essentially, to another department of philosophy. We give to chemistry an allotment in the whole organized economy; but always in entire subordination to the laws of life; whose operations are, therefore, antecedent, and direct the agents they hold in control.

Chemistry, therefore, is wholly against the theories which are founded on mechanical principles, and even against her own laws. Since, if the changes depend on chemical principles, other products should be found; inflammatory action should not be necessary to a particular result, nor should there be a uniformity in the particular modification which attends a secretion from a particular organ, as in inflammations of the mucous membranes, and at a particular stage of inflammation, yet varying, though still uniform, at other stages; nor should there always be a distinctive character to the products of the several modes of inflammation; nor should each organ manifest, in these respects, its own peculiarities, as evinced by the secretions, and the coincident nature, in each part, of its own granulations. Chemistry can do no more than fulfil its legitimate office. The secretions being derived from the blood, should present the elements, and perhaps also, though variously combined and modified, the constituents of that fluid. But even the variable proportions of the natural constituents, as they may be determined by disease, can only be explained by the vital laws.

Blood, according to the ingenious Dr. Babbington, is truly a *homogeneous* fluid, and there is no such thing in nature as lymph and serum. The liquor sanguinis only separates into its component parts, after the laws of vitality cease to operate.* From all which we infer that when lymph, serum, and all other products from the homogeneous, living blood, take place, it can only be through the agency of the vital laws. If, also, we allow vitality to the blood, it is but reasonable to conclude, that its various component, as well as elementary parts, will be held together by the law of vital affinity till that law ceases to operate; or, till it is overcome by the greater and united laws of the secerning vessels. And although the spontaneous separation of the component parts of blood, imply a decline or an extinction of the vital forces, yet no such result may appertain to coagulable lymph when eliminated by the living solids; but the process being a vital one, the vessels of excretion may even endow the lymph with greater vitality.

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* Med. Chirurg. Trans., Vol. XVI. p. 293.

It is an inference, also, not easily resisted, that since the various secretions of the body, in their natural state, depend upon the action of the vital laws, they are equally the product of those laws, when redundant in quantity, or when modified in quality. If physical laws were essentially concerned in the process, many of the facts which we have mentioned could have no existence. If chemical laws mainly operate, then should the products be widely different from the constituents of the blood. These laws are not concerned in diversifying the proportions of those constituents; but in separating their elements and forming new compounds. Such apparently sometimes happens, as seen in the presence of the hydrocyanic acid and saccharine matter in the urine. These form stumbling blocks in our way, from being rare and almost solitary evidences of the possible independent operation of chemical laws in the animal system; its most extraordinary characteristic consisting in its abstraction from the laws of chemistry.

The natural philosopher, relying upon uniformity and universality in the operations of nature, toils at apparent exceptions till they are reconciled to her general laws. And although in physiology, as in the instance to which we are referring, an effort be sometimes made to show that nature is not always consistent, the devious course, like the pursuit of alchymy, will ultimately conduct us to the truth.

The elements of inorganic, and especially of dead organic, matter, are constantly combining spontaneously into specific compounds, again separating, and again uniting to form other combinations. Every part of the animal or the vegetable kingdom is alike composed of those elements, and in definite proportions. They defy, however, the laws of chemistry, whilst they are endowed with life, although as shown by Chevreul and others, their elements, in death, are held together by more feeble affinities than those of inorganic matter. And when the principle of vital affinity gives way, the being that had for years resisted the action of chemical laws may be speedily broken up and the elements may form a multitude of new combinations; but they require for their reconstruction the agency of organized matter. For this purpose, nature has contrived a most elaborate system, in which she has placed the laws of physics and of chemistry in the most perfect subordination to the vital, as if to magnify the grandeur of her operations. We may trace the plan with increasing conviction, without a solitary hope for the materialist, from the infusoria up to man. And yet, with all the complex organization of animals, and all its superior endowments with the vital forces, and we may add, with all the agency of the chemical laws, the elements of what was once organized matter cannot yet be combined till they have felt the creating power of the vegetable world.

These laws are the foundation of an elegant distinction betwixt the vegetable and animal kingdoms; the former subsisting upon inorganic, whilst the latter live upon organic matter; thus manifesting a general final cause of vegetable life, in its supply of nourishment to the higher kingdom; whilst a more specific is seen in the ultimate tendency of the whole process of vegetation to result in means for perpetuating its own species. If the elements which compose organic matter are but few, and their combinations limited and of a specific nature, it only shows the limited agency of the chemical laws. It is the license of these laws, however precise they may be, to operate in the most unrestrained manner, and with only a fortuitous result. But in all living organized matter, the perfection of design is so manifest in its structure, in its functions and products, that we irresistibly admit that it must be withdrawn from the capricious influence of chemical or physical laws.

Had it been consistent with proper brevity, we could have wished to have illustrated the whole subject by analogies drawn from animals that are destitute of a heart, and from the vegetable kingdom. Their healthy and morbid processes, their healthy and morbid products; the infinite varieties that occur in these respects in the latter kingdom, according to the organization and endowments of each species of which it is composed, and yet these varieties always the same; the very limited number of elements that make up the endless variety of the specific products, as well as the organized parts, and many other corresponding facts, reflect a flood of light upon our subject.

Here we see the greatest simplification of the laws and functions of organic life. They are divested of those secondary influences which so constantly embarrass our inquiries in more complex organization; and whilst they are, therefore, better subjects for experimental research, the facts they supply, which are full of analogies, may be safely carried up as analogies to the most complex beings.

Powerful attempts are now making to introduce a new philosophy into medicine and physiology, or to revive an exploded one. Whilst the unique process of inflammation and its results are to be expounded on mechanical principles, a coagulum of blood, long extravasated and long dead, is to be revived and organized, and carry on an isolated life by its own independent resources; and this, too, in the midst of venous blood. By this it is to be nourished, whilst it is known to be fatal when circulating in the nutritive system of other parts. The highest degree of vitality, a mysteriously vivifying influence, far exceeding the *spiritus archæus*, is thus given to the blood, when it is yet undetermined whether it possesses any vitality at all. Coagula of blood are, also, supposed to undergo every variety of spontaneous change that attend the actions of living organized matter; and which have hitherto been referred to the agency of the vital forces. Thus they are said to undergo spontaneous conversions into pus, and by those who believe that pus is at other times a secretion; to change into calcareous matter arranged in concentric layers, although there may have been originally no lime in the clot; into carcinomatous, melanotic, lardaceous, hœmatodic, mammary and scrofulous degenerations, &c. The glandular structures are to be mere strainers of the blood, and the secretions, the matters strained. And to finish the climax, the humoral pathology is to simplify disease in such a manner, that according to a truly eminent physician,

> "Passing by this organ and that, and this function and that secretion, we penetrate the spring and source of all, even to the blood itself, and there find the seminal principle of disease; and that this, in hitherto most fatal of all fevers, may be remediable by the simplest means, which are always at hand."*

This simple means is the muriate of soda.

These subjects have all an important bearing upon the Hunterian philosophy of inflammation; and a blow has been, therefore, not only directly, but indirectly, given to the proudest monument of Hunter's fame; and may we not say, to some of the most sublime conceptions of nature? Whatever relates to Mr. Hunter is imbued with an exciting interest. But it might not, perhaps, become a foreign hand to shield the fame of Hunter, whilst England watches in the field of science. We may at least, however, protect those fundamental principles which are the bulwark of medicine, should we be striving, side by side, with their immortal author. Would that we are not mistaken. That we do not bow before an idol. That the wreath he has worn has not been composed of the flowers of fancy; and that he will still continue to preside in the temple of his own creation.

New York, Feb., 1838.

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* Dr. Latham on "Subjects connected with Clinical Medicine," p. 53.

Fig. 1.

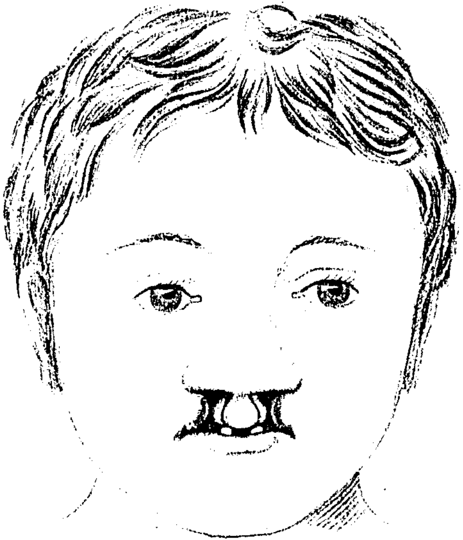

Fig. 2.

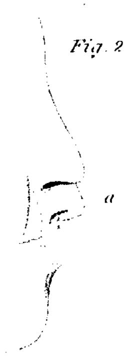

Fig. 3.

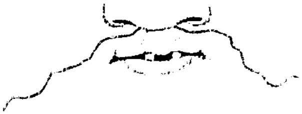

Fig. 4.